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In replying please address:



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March 5, 1957

Dear Sir:

On the basis of recent discussions with your technical representative, we are submitting herewith a proposed program for a 10-month period of research directed toward the development of an electrically powered implement to assist in laying wire underground. This proposed program has developed from the research conducted previously under Research Order No. 21 and Work Order No. VI, Task Order No. A.

If you should have any questions with regard to this proposal, please let us know. Any inquiries of a contractual nature may be addressed to



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Very truly yours,



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Director

EDT:vh

Enclosure

In Duplicate

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SECRET**PROPOSED RESEARCH PROGRAM****on****THE DEVELOPMENT OF AN ELECTRICALLY POWERED
IMPLEMENT TO ASSIST IN LAYING WIRE UNDERGROUND****INTRODUCTION**

On February 1, 1955, Research Order No. 21 was undertaken to conduct research directed toward the development of an implement which would facilitate the laying of wire underground. By using such an implement, an operator would be able to dig a narrow trench for use in placing wire approximately 36 inches below the surface of the ground. The trenching unit of interest was to be portable, relatively quiet, rapid in operation, and independent of a remote source of power.

Our efforts under Research Order No. 21 resulted in the development of a prototype gasoline-engine-powered device weighing only 94 pounds that could dig a trench 1-1/4 inches wide and 36 inches deep at a rate of 4-1/2 feet per minute by means of a roller chain equipped with rip-saw-type teeth. The Sponsor found that this experimental device was satisfactory from the standpoint of portability, ease of handling, and rate of trenching. However, during operation of this experimental gasoline-engine-powered device, the noise from the power unit was so loud that the potential applicability of the device under certain field conditions appeared to be limited.

On June 20, 1956, Work Order No. VI, Task Order No. A, was undertaken to investigate the feasibility of an electric-motor-driven device similar to the prototype gasoline-engine-powered unit developed under Research Order No. 21. As described in the Work Order No. VI summary report

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dated October 2, 1956, we were able to demonstrate that it was practical to trench to a depth of 18 inches at a rate of about 8 feet per minute with a Type 1 Prototype Trenching Unit modified to accommodate a 2-horsepower electric motor, which was the highest-capacity unit that was readily available to us. We were also able to locate commercially available 2-1/2-horsepower electric motors and power-generating equipment, which appeared to be suitable for use with such motors and could be driven by an automobile engine. Because of the successful outcome of this feasibility study, your technical representative is interested in research on the development of prototypes of an electrically powered device which would dig a trench 18 inches deep, and of appropriate power-supply units, which could be installed in a Volkswagen.

DESCRIPTION OF THE PROBLEM

There are two primary problems associated with the development of a prototype electrically powered trenching unit. The first is concerned with supplying the necessary powering energy by means of an electric motor which can be easily carried. The second involves the adaptation of the power-supply equipment to a small car such as the Volkswagen. Preliminary investigations have shown that an adequate trenching rate can be obtained using a 2-horsepower electric motor as the power unit; a modified Type 1 Prototype Trenching Unit equipped with a 2-1/2-horsepower electric motor could be expected to trench at an even more satisfactory rate. Inquiries to different manufacturers have revealed that a 400-cycle, a-c, 2-1/2-horsepower electric motor that weighs approximately 9 pounds is available. If such a motor were

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adapted to the prototype trenching unit developed under Research Order No. 21, the weight of the resulting trenching device would be approximately 70 pounds. It therefore appears that a 400-cycle, a-c, 2-1/2-horsepower motor would be satisfactory for the proposed application.

As currently contemplated, it would be necessary for the power to be supplied to the proposed electric trencher from an automobile. To minimize the possibilities of attracting undue attention, it is anticipated that the motor of the car should be idling during power takeoff. Preliminary investigations have shown that adequate power can probably be generated by a d-c generator located in the engine compartment and an inverter positioned in the luggage compartment. If the necessary equipment were available, it might also be possible to obtain the power directly from an alternator placed in the automobile engine compartment. In addition to the power-generating equipment, which would weigh approximately 150 pounds, cable would have to be stored in the automobile. At the present time, it appears that 300 feet of appropriate electrical cable, weighing approximately 100 pounds, could be stored satisfactorily in an automobile such as the Volkswagen.

OBJECTIVE

The objective of this proposed program would be to conduct research directed toward (1) the design and development of two prototypes of an experimental electrically powered trenching unit that would trench to a depth of 18 inches, and (2) the preparation of two prototypes of a power-supply unit for the experimental electrically powered trenchers and the adaptation of one

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of the experimental power-supply units to a Volkswagen.

GENERAL PROCEDURE

At the start of the proposed research program, additional information would be obtained concerning 2-1/2-horsepower, 400-cycle, a-c motors and the equipment that could be assembled to supply the power required for such motors. Also, a Volkswagen automobile would be ordered.

When sufficient information concerning the electric motors and power-supply units had been obtained, preliminary design layouts would be prepared for the proposed experimental trenching unit and for the power equipment positioned in the Volkswagen. These preliminary layouts would be discussed with your technical representative; after the most suitable preliminary designs had been selected on the basis of mutual agreement, the electrical components needed would be ordered.

We anticipate that up to five months might be required to procure the necessary electrical components and up to six months, to obtain the Volkswagen. While awaiting delivery of these units, we would design the experimental trenching unit and prepare two prototypes. The digging chain and chain guide of the proposed experimental unit would be almost identical to those developed under Research Order No. 21; however, the design of the chassis would be changed to accommodate the electric motor, and to provide the drive for the digging chain. After the design activity had been concluded, preparation of the necessary parts other than those being procured would be undertaken. It is anticipated that the above-indicated necessary

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parts would be ready for assembly several weeks before delivery of the commercially available electrical components; the activity on the proposed program would be reduced until these components were received.

Upon receipt of the electrical components, the motors would be assembled in the experimental trenching units and the installation of the power-supply equipment in the Volkswagen would be started. We believe that the assembly of all of the experimental units would be concluded by approximately the end of the sixth month of the proposed research period.

The experimental units would then be evaluated extensively. The evaluation would be concerned primarily with the performance of the prototype power-supply unit and with the trenching rates obtainable with the experimental trencher. In particular, we feel that the reliability of the different electrical components under adverse handling conditions should be established. Any necessary modifications would be decided upon by mutual agreement subsequent to our evaluation and following operation of the experimental units by your technical representatives. The agreed-upon modifications would be made and the experimental units would undergo further evaluation, including the establishment of trenching rates under different soil conditions. Also, the recommended procedures for handling the prototype trenching and power-supply equipment would be firmed up. It is possible that, at this stage, the experimental units would be delivered to your technical representative for field testing. Subsequently, modifications, if any, suggested by the field-testing experience would be discussed; if possible within the limits of the estimated research period and funds, these would be incorporated in the experimental units, and evaluated.

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To save time, it is recommended that the proposed contract contain express approvals for the procurement of the Volkswagen, inverters, generators, and motors, which would be utilized as described above. As an alternative, the Contracting Officer could grant these approvals in an accompanying letter.

REPORTS AND LIAISON

Monthly letter reports describing the progress of the program would be prepared. These would be supplemented by periodic meetings with your technical representative. At the end of the proposed research period, a summary report would be prepared that would include a description of the research performed, the experimental units prepared, and the recommended handling procedures.

DURATION AND ESTIMATED COSTS

It is proposed that the contract provide for a 10-month period of research, with an estimated appropriation of \$25,015, including the fixed fee.

The general breakdown of the estimated costs is attached.

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THE CONTRACT

The proposed contract would be a period-basis research agreement, consistent with our current contractual arrangements and providing only for a fixed period of research leading toward the objective outlined in this proposal.

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Proposal of _____ the U. S. Government.
 For Research on **The Development of an Electrically Powered Implement to Assist in Laying Wire Underground.**

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Based upon a period-basis Contract for a research period of **10 months.**

(Including time for submission of all reports. The proposed contract will not provide for earlier conclusion of the research.)

ESTIMATED COSTS

We expect that the cost of this research for the period indicated above may be distributed approximately as set forth hereon, subject to the understanding that this allocation is merely an estimate, and actual costs incurred may vary from the categories shown. We have determined that these estimates are reasonable and consistent with Battelle's established policies in its research for the various Government agencies, which policies are briefly discussed below and will be followed in determination of our actual costs hereunder.

Materials & Supplies, etc.

\$ 6,500

(Including any equipment which may be purchased as necessary in performance of the research. Charges of \$25 or less are excluded from this item.)

Use of Equipment and Technical Services, Travel, and Misc.

\$ 2,700

(Including applicable costs of technical research and service divisions, and use of technical equipment, except that any undistributed balances of these accounts will be included in overhead. Cost of travel includes reasonable actual subsistence expenses and the actual cost of transportation. An allowance of up to 7¢ per mile for all necessary travel by privately owned conveyance is included in lieu of the cost of such travel.)

Salaries & Wages

(Including our predetermined accrual for vacation, holiday, and sick-leave pay, pensions, and social security.)

Type of Employee	No. of Man-Months	Estimated Cost
Supervision	2	\$ 2,000
Research Engineers	6	4,110
Lab. Assistants	8	3,200
Steno., Clerical, Shop & Photo., etc.	1	290
Total Salaries & Wages		\$ 9,600

Overhead

50 per cent [or such other provisional rate as may from time to time be mutually agreed upon with the Government's audit representatives] of salaries and wages, as they are defined above. This is a provisional rate for current reimbursement, which we have arrived at by negotiation with Government representatives, and it will be subject to retroactive revision to the "actual" rate agreed upon with them for each calendar year following a detailed audit for that year. The item of overhead includes general research, charges of \$25 or less for materials and supplies, and other categories of costs we customarily include in our overhead account. Cash discounts on all purchases will be credited to overhead, instead of to the amount of the purchase. Scrap of appreciable value will be credited directly to the project. All other scrap will be credited to the overhead account, in which the Government participates.)

\$ 4,800

Total Estimated Cost

\$ 23,600

Fixed Fee

1,415

Contract Price

\$ 25,015

Please let us have your acceptance in our hands by **April 15, 1957.**

Unless we extend the time, your acceptance after that date will be subject to agreement.

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